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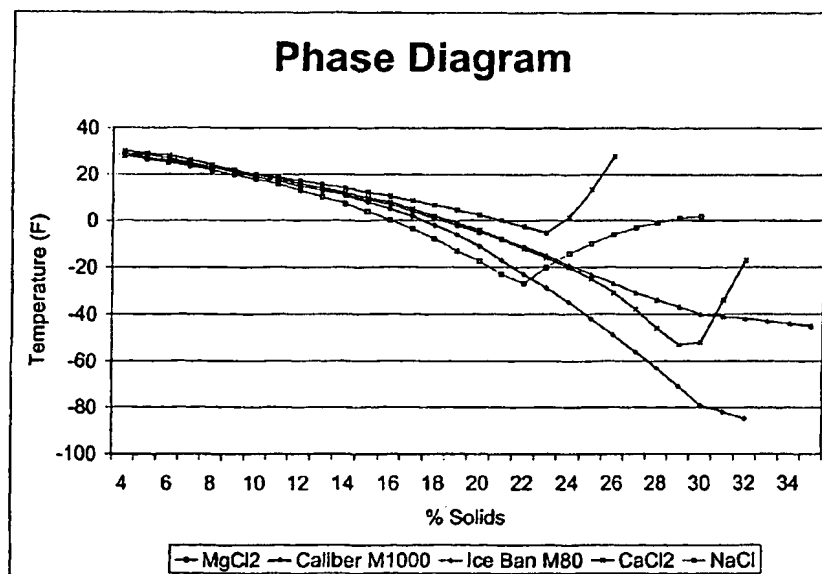
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(54) Title: DE-ICING COMPOSITION AND METHOD



(57) Abstract: A composition for reducing the buildup of snow and ice on a surface. The composition includes a sugar-water mixture having approximately 15 to 80 percent by weight of a sugar solid, wherein the sugar solid contains approximately 2-60 percent by weight of a monosaccharide. The Figure illustrates a phase data chart and diaphram for one embodiment of the invention, Caliber M1000, compared to a magnesium chloride brine, a calcium chloride brine, a sodium chloride brine, and a commercial product known as Ban M80.

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Title: De-icing Composition and Method**FIELD**

This invention relates to a de-icing composition and method for reducing the buildup of snow and ice on roads and other outdoor surfaces. More particularly, this invention relates to a de-icing composition and method that exhibits low corrosive affects, has a low eutectic point, and is environmentally safe.

BACKGROUND

5 Chloride salts have been applied on roads to inhibit the accumulation of snow and ice for many years. Such chloride salts may be applied to the surface of the road directly in solid form or in admixture with water or some other liquid. Spreaders, for instance, may apply solid or liquid de-icing compositions somewhat evenly over the surface of roads. Other substances, such as sand, may also be applied to the road with the solid or liquid
1 composition having chloride salts to treat the roads and help reduce slipping on the road.

Brine solutions that contain high concentrations of earth metal and chloride ions are commonly used for application to roads. As long as the concentration of ions in the brine solution remains high enough, the solution remains in a liquid form and is useful as a de-icer. Once the solution is diluted below a critical ion concentration for a specific temperature, ice
6 crystals begin to form in the solution and it is no longer useful as a de-icer.

Chloride salts and brine solutions have numerous problems as road de-icers. A first problem is that typical brine solutions containing chloride salts do not exhibit useful melting properties below, at the lowest, about -5 deg. F. A second problem is that such brine solutions impact the environment in negative ways. They may damage the soil and

1 vegetation surrounding the road, in large part because of the salts, they may adversely
impact surrounding lakes, rivers, or streams, and the compounds may be absorbed into
water supplies. A final problem is that such brine solutions may exhibit corrosive effects,
damaging vehicles on roads as well as the structure of the roads themselves. Many states
have therefore limited the use of salt on roads.

6 De-icing compositions and methods have been developed that partially solve some
of the above problems of prior de-icing compositions and methods. U.S. Patent No.
4,676,918 to Toth et al., for instance, discloses an anti-freeze composition for prohibiting
the buildup of snow and ice that contains, as a primary component, a waste concentrate of
the alcohol distilling industry. U.S. Patent Nos. 5,635,101; 5,709,812; and 5,709,813, all
1 of which name Janke et al. as inventors, disclose the use of steepwater solubles from the
wet milling process for corn, whey, and wine making residue respectively as the primary
ingredients in de-icing compositions. According to these patents, the compositions
disclosed therein provide environmental and corrosive-inhibiting benefits over salt de-icers.

These prior art de-icing compositions also have numerous disadvantages and
6 problems. The freezing point of such de-icing compositions are typically not as low as may
be desirable. Such compositions may contain a higher level of insoluble material than is
desirable, which makes it more difficult to mix into liquid de-icers which may be easily
spread onto roads. These de-icing compositions may also contain materials that may be
harmful to the environment. For instance, some steepwater solubles compositions contain a
11 large amount of phosphorus, which may be harmful to the environment. Typical steepwater
solubles de-icing compositions have a pH around 3.0. Because a neutral pH (7.0) or a pH

1 as close to neutral as possible is desirable for the environment, such steepwater solubles de-
icing compositions may harm the environment.

An improved de-icing composition and method is needed that is environmentally
safe, has a low freezing point and thus melts a large amount of snow and ice by suppressing
ice crystal formation, exhibits low corrosive effects, and that maintains a high viscosity at
6 low temperatures. Such a de-icing composition and method preferably solves the above
problems of prior art de-icing compositions and is inexpensive to produce in large
quantities.

SUMMARY

One embodiment of the invention is a composition for reducing the buildup of snow
1 and ice on outdoor surfaces comprising a sugar-water mixture. A variety of sugars may be
used within the scope of the invention, and the sugars may be also be used in a variety of
concentrations. For example, sugar concentrations as low as 5% may be useful as de-icing
agents without other additives to the de-icing agent. Sugar concentrations as low as 1%
may be useful as de-icing agents when mixed with a brine solution.. Another embodiment
6 of the composition of the invention comprises adding a brine solution to the sugar-water
mixture. A variety of salts, including magnesium chloride, may be used within the scope of
the invention. The brine mixture and the sugar-water mixture may be combined in varying
amounts to form the composition of the invention.

Another embodiment of the invention is a method for reducing the buildup of snow
1 and ice on outdoor surfaces comprising applying a sugar-water mixture to the surface of the
outdoor surface.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a graph showing phase data for embodiments of the invention compared to prior art de-icers.

Figure 2 is a chart depicting the melting capacity for various embodiments of the composition of the invention compared to prior art blends.

Figure 3 is a chart that shows phase data for various embodiments of the invention, as well as for various prior art blends.

Figure 4 is a chart showing the ice penetration for rock salt compared to rock salt treated with a composition of the invention.

Figure 5 is a graph showing the percent increase in ice penetration of rock salt treated with a composition of the invention compared to untreated rock salt.

Figure 6 is a chart showing the reduced corrosion caused by one composition of the invention over prior art blends.

Figure 7 is a second chart showing the reduced corrosion caused by one composition of the invention over prior art blends.

Figure 8 is a graph showing the viscosity of a composition of the invention compared to the viscosity of prior art blends.

Figure 9 is a graph of the friction value for a dry road compared to a road treated with an embodiment of the invention as the humidity varies over time.

DETAILED DESCRIPTION**A. General Overview**

The de-icing embodiments of the invention discussed below may be used as anti-icing or de-icing agent on surfaces, such as outdoor surfaces, or for pre-wetting of solids or pre-treating of stockpiles of solids to be used as anti-icing or de-icing agents. Any of the compositions described below may be applied to surfaces at varying rates as de-icing compositions.

One embodiment of the invention is a composition for reducing the buildup of snow and ice on outdoor surfaces. In this embodiment, the composition contains a sweetwater (sugar-water) mixture. Another embodiment of the composition of the invention comprises adding a brine solution to the sweetwater mixture. The brine mixture and the sweetwater mixture may be combined in varying amounts to form the composition of the invention. A corrosion inhibitor may also be added to the composition. In addition, a steepwater solubles mixture, which may function partially as a corrosion inhibitor, may be added to the composition. The composition of the invention may contain sweetwater and, optionally, any combination of brine, steepwater solubles, and a corrosion inhibitor. Further, the composition of the invention may, in one embodiment, contain any combination of the ingredients listed above in a dry matter form.

A variety of sugars may be used within the scope of the invention. In one embodiment, the invention may contain a sugar solution (sweetwater) with as little as 5% sugar solids. Such a mixture may exhibit desirable corrosion characteristics and a sufficiently low eutectic point to suffice as a de-icing agent. In another embodiment,

1 sweetwater may be mixed with a brine solution such that the mixture of sweetwater and
brine contains as little as 1% sugar solids, and the mixture may suffice as a de-icing agent
with beneficial characteristics over a pure brine solution.

B. The Sugar of the Invention

 Within the scope of the invention, a variety of sugars may be used, including but not
6 limited to corn sugar, cane sugar, beet sugar, sorghum sugar, maple sugar, wheat sugar,
tapioca sugar, potato sugar, cassava sugar, and manioca sugar. The composition of the
invention may contain a sugar-water mixture, or, in another embodiment, the composition
may contain a de-icing agent that is a sugar solid. In one embodiment of the invention, the
sugar solid may contain approximately 2-60 percent by weight of a monosaccharide. In
11 other embodiments, the sugar solid may contain about 6-39 percent by weight of the
monosaccharide, or 12-18 percent by weight of the monosaccharide solid. In yet other
embodiments, the sugar solid may contain about 14 percent by weight of the
monosaccharide. The term "monosaccharide" will be used throughout this specification to
refer to a single molecule sugar unit, such as, but not limited to, dextrose. The balance of
16 the sugar solid may be polymers of dextrose.

 One embodiment of the invention uses 25 Dextrose Equivalent (D.E.) corn syrup
(CSU) in the sweetwater, although other varieties of corn syrups may also be used. One
suitable 25 D.E. corn syrup has the following profile:

21 77.5 % solids
5.0 pH
0.3% ash
carbohydrate profile on a dry solid basis (D.S.B.)
dextrose: 8%
maltose: 8%

1 malt-triose: 8%
 higher saccharides: 76%

The 25 D.E. corn syrup may be diluted with water to about 40 percent solids, although any concentration of 25 D.E. corn syrup could be used, such as 30-70 percent solids. This 25 D.E. corn syrup diluted to 40 percent solids may then be mixed with other substances, in particular chloride salts, in varying ratios to produce a mixture with desired melting capacities and corrosion characteristics. It should be noted that the final percent solids in the mixture may be a significant number for performance of the mixtures of the invention.

6
1 Another embodiment of the invention uses 36 D.E. corn syrup (CSU) in the sweetwater. One suitable 36 D.E. corn syrup has the following carbohydrate profile on a dry solid basis:

 dextrose: 14%
 maltose: 11.5%
 malt-triose: 10.5%
 higher saccharides: 64%

6 In addition, 43 D.E. corn syrup, 63 D.E. corn syrup, and other corn syrups could also be used in the sweetwater. The corn syrup or other sweetwater of the invention may be used in varying percent sugar solids. For example, in one embodiment, the corn syrup or sweetwater may have a sugar solids percent of about 15-90 percent. In other embodiments, the corn syrup or sweetwater may have 15-80 percent sugar solids, 30-75 percent sugar solids, 40-70 percent sugar solids, 50-70 percent sugar solids, or 60 percent sugar solids. The corn syrup used within the scope of the invention may be made by any process known to those skilled in the art, including a wet corn milling process.

1 In one embodiment, a sugar profile of the corn syrup may be about 2-60 percent
dextrose, 2-60 percent maltose, 2-60 percent maltotriose, and 15-80 percent polymers of
dextrose. In another embodiment, the sugar profile of the corn syrup may be about 14
percent dextrose, 11-12 percent maltose, 10-11 percent maltotriose, and 64 percent
polymers of dextrose. In still other embodiments, the sugar solid contains approximately 6-
6 40 percent by weight of the monosaccharide, approximately 12-18 percent by weight of the
monosaccharide, or approximately 14 percent by weight of the monosaccharide.

C. Salt and Additives

 As noted above, a variety of additives may be mixed to the sweetwater solution
within the scope of the invention to enhance the performance characteristics of the
11 sweetwater as a de-icing composition. A variety of chloride salts, including magnesium
chloride, calcium chloride, sodium chloride, or potassium chloride may be added to the
sweetwater. Such salts may be added in widely varying quantities. In one embodiment, a
brine solution may be added to the sweetwater of the composition. In different
embodiments, the brine mixture may contain approximately 15-70 percent salt, 15-60
6 percent salt, or 30-70 percent salt.

 Other additives that may enhance the performance of the sweetwater as a de-icing
agent include rock salt, sand, cinders, abrasives, gravel, urea, calcium magnesium acetate
(CMA), potassium acetate (KAC), and any other additives known to those skilled in the
art. Other additives, such as lactic acid, glycerol, citric acid, or acetic acid may also be
11 added to the sweetwater within the scope of the invention. In addition, thickeners known to
those skilled in the art, such as xanthum gum, may be used to enhance the viscosity profile

1 of the embodiments of the invention. It should be noted that a mixture of the invention containing CMA may form a product that is more environmentally friendly and offers improved corrosion characteristics over a product containing a salt solution, as chloride salts can cause numerous environmental problems on both land and in water.

6 In one embodiment, a sweetwater composition may be mixed with a 30% magnesium chloride brine, which is commonly available and used commercially as a road de-icer. Other concentrations of magnesium chloride brine or other brine solutions may also be used. The magnesium chloride brine and sweetwater may be mixed in a number of different ratios, each of which produces different performance characteristics.

D. The Corrosion Inhibitor

11 One embodiment of the composition of the invention contains a corrosion inhibitor. Any commercially available corrosion inhibitor may be used within the scope of the invention. One such corrosion inhibitor is sodium citrate, which may have a 7.0 pH. The sodium citrate (7.0 pH) solution may be added to the mixture to enhance the corrosion characteristics of the product.

6 The composition of the invention may also contain additional additives to enhance the properties of the mixtures. For example, steepwater (sometimes referred to as s.w., condensed fermented corn extractives, or steepwater solubles) may be used as an additive in varying amounts to enhance corrosion characteristics and/or other characteristics of the invention. The term "corrosion inhibitor," therefore, may refer to any commercially available
1 product to inhibit corrosion, or to any blend of corrosion inhibiting products, including a blend of steepwater and sodium citrate. In one embodiment, the steepwater may be about

1 20 to 80 percent by weight solids with the balance being water. In other embodiments, the steepwater may be about 30-70 percent solids, 40-60 percent solids, or 50 percent solids.

 The steepwater used within the scope of the invention may be made by any type of process known to those skilled in the art. In one typical steeping process, corn is soaked in water for about 20 to 40 hours. Approximately 0.1 percent sulfur dioxide is added to the
6 water to facilitate the steeping process. The corn then begins to soften and swell. The mild acidity of the water loosens the gluten bonds within the corn and releases the starch. The corn is then removed and goes on to further processing. The resulting water in the tank is called light corn steep liquor, which may be condensed into steepwater (condensed corn steep liquor). Different processing plants may have variations in the analysis of the
1 steepwater produced depending on the process and the composition of the corn. Some wet corn milling plants also produce ethanol, with the resulting wet distillers solubles co-product being frequently added to the steepwater with the resulting mixture still being referred to as steepwater. As used in this specification, therefore, "steepwater" refers to a blend of the steepwater produced from wet corn milling or to the steepwater produced
6 from wet corn milling with distillers solubles or corn syrup refinery insolubles. Any liquid byproduct from agricultural processing that is used in an animal feed of the invention may be produced in any manner known to those skilled in the art.

E. Examples

 In one embodiment, the sweetwater composition may be combined with a
1 steepwater solubles-water admixture containing approximately 20 to 80 percent by weight of steepwater solubles. This embodiment may also contain a brine mixture containing

1 approximately 15 to 60 percent salt. In one embodiment, this composition may contain about 50-95 percent by volume of the brine mixture, 5-50 percent by volume of the sugar-water mixture, and 0.5-5 percent by volume of the corrosion inhibitor.

6 In another embodiment, about 1-10 percent by volume of a corrosion inhibitor may be mixed with about 90-99 percent of a sugar-water mixture to form the composition of the invention. Typically, however, a corrosion inhibitor may only be needed in embodiments of the composition that contain a chloride brine. In addition, steepwater, which may serve as a corrosion inhibitor, may, in some embodiments, only be used in embodiments of the invention that contain chloride brines.

1 In another embodiment, the composition may have approximately 15-50 percent by weight on a dry basis of a sugar solid, approximately 60-90 percent by weight on a dry basis of a salt, and approximately 0.05-2 percent by weight on a dry basis of a corrosion inhibitor.

6 In still other embodiments, a sugar-water mixture having approximately 15 to 80 percent by weight of a sugar solid may be added with a brine containing 15-40% salt by weight to form the composition of the invention. A corrosion inhibitor may also be added to this composition to form a composition having approximately 50-95 percent by volume of the brine, 5-50 percent by volume of the sugar-water mixture, and 0.5-5 percent by volume of the corrosion inhibitor.

1 In another embodiment, a steepwater solubles-water admixture may be combined with a sugar-water mixture and a brine mixture to form the composition of the invention. In such an embodiment, the composition may contain about 80 percent by weight of the brine

1 mixture, 6 to 7 percent by weight of the steepwater solubles-water admixture, and 13 to 14 percent by weight of the sugar-water mixture. In another variation, such a composition may contain about 50-95 percent by volume of the brine mixture, 0.5-20 percent by volume of the steepwater solubles-water admixture, and 5-50 percent by volume of the sugar-water mixture.

6 In one embodiment, the composition may have about 90-95 percent by volume of the sugar-water mixture, 4-9 percent by volume of the steepwater solubles-water admixture, and 0.5-2 percent by volume of a corrosion inhibitor of sodium citrate.

One specific embodiment of the composition contains 92.5% by volume of a 36 D.E. corn syrup at about 60 percent solids, 6.4 percent by volume of steepwater at about 50 percent solids, and 1.1 percent sodium citrate at about 32 percent solids. Such a material, which will be referred to as Blend No. 1, could be mixed with varying amounts of steepwater, although in some embodiments, steepwater may only be used in embodiments of the blend containing chloride brines in which a corrosion inhibitor may be desired. If brine is added to Blend No. 1, therefore, it may also be desirable to add steepwater to the blend, which may function as a corrosion inhibitor. In addition, magnesium chloride brine, calcium chloride brine, or sodium chloride brine could be mixed with Blend No. 1 to produce de-icing compositions.

Another embodiment of the invention is a blend of 25 D.E. corn syrup at about 40 percent solids. Such a blend may be mixed with magnesium chloride to form a blend of about 10 percent by volume of the 25 D.E. corn syrup and 90 percent by volume of the magnesium chloride brine. In other embodiments, the 25 D.E. corn syrup may be mixed

1 with magnesium chloride brine to form a product with a ratio of brine to corn syrup of 80:20 or 60:40.

Blend No. 1 may be also be mixed with brines to form blends of varying composition. One blend, referred to throughout the attached Figures 1-9 as "Caliber M1000," may contain about 90 percent magnesium chloride brine by volume and 10 percent of Blend No. 1 by volume. Another blend, referred to as "Caliber M2000," may contain about 80 percent magnesium chloride brine by volume and 20 percent of Blend No. 1 by volume. Still other blends may have about 15 percent of Blend No. 1 and 85 percent by volume of a calcium chloride brine. Such a blend is referred to in Figures 1-9 as "Caliber C1500." Another blend, referred to in Figures 1-9 as "Caliber C1000-LS," may contain about 10 percent calcium chloride brine by volume and about 90 percent Blend No. 1 by volume. Another embodiment, referred to as "Caliber S1000," may contain about 90 percent sodium chloride brine by volume and 10 percent of Blend No. 1 by volume.

Figures 1-9 depict various properties and characteristics of embodiments of the invention. In general, a number of characteristics may be desirable for a de-icing composition of the invention, such as a low eutectic point, a pH near 7.0, and a low corrosion percentage. Figure 1 illustrates a phase data chart and diagram for one embodiment of the invention, Caliber M1000, compared to a magnesium chloride brine, a calcium chloride brine, a sodium chloride brine, and a commercial product known as Ice Ban M80. The products referred to as "M50" and "M80" throughout this specification are commercially available products known as Ice Ban M50 and Ice Ban M80, and are manufactured and sold by Natural Solutions, Inc. of Chesapeake, Virginia. In Figure 1, the

1 percent solids refers to the overall percentage of solids in the solution tested, and different
percentages indicate that various amounts of water were added to the solution tested. As
Figure 1, illustrates, the embodiment of the invention referred to as Caliber M1000 has a
lower eutectic point at a percent solid of about 30-34 percent and also at any point above
about 22 percent solids. Figure 1 also shows that certain of the tested blends, such as
6 magnesium chloride, calcium chloride, and sodium chloride, drop crystals at certain percent
solids, and hence the right end of the graph for these blends veers upward. Such an effect
does not take place with the embodiment of the invention referred to as Caliber M1000.
Figure 3 is a chart that shows phase data (eutectic point at different percent solids, which is
referred to as "%DS" in Figure 3) for various embodiments of the invention, as well as for
1 various prior art blends.

Figure 2 is a chart depicting the melting capacity for various embodiments of the
composition of the invention compared to prior art blends. The reference to a melting
capacity refers to the grams of ice melted per gram of product at varying temperatures (as
shown on the horizontal axis) in 20 minutes. Figure 2 shows that the embodiment of the
6 invention referred to as Caliber M1000 has a melting capacity that comes close to meeting
or exceeding the melting capacity of other common blends, and in particular a 30 percent
magnesium chloride blend. At low temperatures, such as 0 deg. F. or -10 deg. F., Figure 2
shows that the Caliber M1000 blend has a greater melting capacity than any of the other
listed blends.

11 Figure 4 is a chart showing the ice penetration for rock salt compared to rock salt
treated with Caliber M2000. To treat the rock salt, 8 gallons of Caliber M2000 was added

1 to each ton of rock salt. The reference to ice penetration refers to the amount of
penetration of the product in millimeters at 5 deg. F in 20 minutes. As Figure 4 indicates,
the treated rock salt has a greater penetration than the untreated rock salt. Figure 5 shows
the percent increase in ice penetration of rock salt treated with Caliber M2000 as described
above over untreated rock salt. Figure 5 shows a significant increase in percent ice
6 penetration for salt treated with compositions of the invention, particularly at low
temperatures.

Reduced corrosion is one benefit of the compositions of the invention, and Figures 6
and 7 illustrates such benefits. In Figures 6 and 7, salt is the standard by which
corrosiveness is measured, and salt therefore has a corrosion percent of 100 percent.
11 Magnesium chloride brine, as Figures 6 and 7 illustrate, is slightly less corrosive than salt
(sodium chloride). The embodiments of the invention described above as Caliber M2000
and Caliber M1000 have a significantly lower corrosive effect than salt – around 10 percent
or less of the corrosiveness of salt.

In one embodiment, the composition of the invention is designed to be slightly more
16 viscous than a chloride brine, which aids in the ability to apply the composition to a surface,
but less viscous than the commercial product known as Ice Ban M50. Figure 8 shows the
viscosity of chloride brines, two Ice Ban products, and an embodiment of the composition
of the invention known as Caliber M1000. As Figure 8 depicts, the viscosity profile
changes with temperature. The viscosity of the embodiment known as Caliber M1000 has
21 the desired viscosity profile between that of chloride brines and Ice Ban M50.

1 Figure 9 is a graph of the friction value for a dry road compared to a road treated
with Caliber M1000 as the humidity varies over time. As Figure 9 shows at the left hand
side, a surface treated with Caliber M1000 will be more slick than a dry road (i.e., a road
with no moisture on it). The surface treated with Caliber M1000, however, will not be
significantly more slick than a wet road. As the humidity increases (between about 25 and
6 100 minutes on Figure 9), the surface treated with Caliber M1000 is the least slick surface
– less slick than a dry road. The right hand side of Figure 9 shows that when the humidity
decreases, the slickness of the Caliber M1000 treated surface increases, but it does not get
significantly more slick than a wet surface.

 The embodiments of the invention discussed above offer a variety of advantages
1 over the prior art. One advantage is that the effective temperature range of the
embodiments of the invention are considerably lower than commercially available brine
solutions that are commonly used. Such brine solutions are usually ineffective at
temperatures below approximately 5 deg. F. The embodiments of the invention may
therefore be effective at lower temperatures and may have greater efficiency at higher
6 temperatures than do currently available de-icing products. Another related advantage of
the embodiments of the invention is a low eutectic point.

 Other advantages of the embodiments of the invention include low corrosion, an
enhanced or higher viscosity so that the product will remain on the road or surface of
application for a longer period of time, and increased ease of handling over commercially
1 available products. The embodiments of the invention may also reduce the impact on the
environment because the embodiments of the invention contain less chloride than most

1 commercially available de-icing products and are organic and hence biodegradable. In
addition, because the embodiments of the invention offer higher performance such that a
smaller amount of the embodiments of the invention may have the same effect as a large
amount of a prior art de-icing agent, smaller amounts of the embodiments of the invention
may be applied to a surface and less environmental harm will result than for prior art de-
6 icing agents.

While the present invention has been described with reference to several
embodiments thereof, those skilled in the art will recognize various changes that may be
made without departing from the spirit and scope of the claimed invention. Accordingly,
this invention is not limited to what is shown in the drawings and described in the
1 specification but only as indicated in the appended claims. Any numbering or ordering of
elements in the following claims is merely for convenience and is not intended to suggest that
the ordering of the elements of the claims has any particular significance other than that
otherwise expressed by the language of the claims.

CLAIMS

What is claimed is:

1. A composition for reducing the buildup of snow and ice on a surface, comprising:
a sugar-water mixture having approximately 15 to 80 percent by weight of a sugar solid, wherein the sugar solid contains approximately 2-60 percent by weight of a monosaccharide.
2. The composition of claim 1, wherein the sugar-water mixture contains approximately 40 percent by weight of the sugar solid and approximately 60 percent by weight of water.
3. The composition of claim 1, further comprising a steepwater solubles-water admixture containing approximately 20 to 80 percent by weight of steepwater solubles and approximately 20 to 80 percent by weight of water.
4. The composition of claim 1, further comprising a corrosion inhibitor.
5. The composition of claim 4, wherein the corrosion inhibitor is sodium citrate.
6. The composition of claim 4, further comprising a brine mixture containing approximately 15 to 60 percent salt.
7. The composition of claim 6, wherein the composition comprises about 50-95 percent by volume of the brine mixture, 5-50 percent by volume of the sugar-water mixture, and 0.5-5 percent by volume of the corrosion inhibitor.
8. The composition of claim 6, wherein the salt is selected from the group consisting of magnesium chloride, sodium chloride, calcium chloride, and potassium chloride.
9. The composition of claim 1, wherein the sugar-water mixture is corn syrup.

1 10. The composition of claim 9, wherein a sugar profile of the corn syrup is about 2-60 percent dextrose, 2-60 percent maltose, 2-60 percent maltotriose, and 15-80 percent polymers of dextrose.

 11. The composition of claim 9, wherein a sugar profile of the corn syrup is about 14 percent dextrose, 11-12 percent maltose, 10-11 percent maltotriose, and 64 percent
6 polymers of dextrose.

 12. The composition of claim 1, wherein the sugar solid contains approximately 6-40 percent by weight of the monosaccharide.

 13. The composition of claim 1, wherein the sugar solid contains approximately 12-18 percent by weight of the monosaccharide.

11 14. The composition of claim 1, wherein the sugar solid contains approximately 14 percent by weight of the monosaccharide.

 15. A composition for reducing the buildup of snow and ice on a surface, comprising:
 a de-icing agent containing a sugar solid, wherein the sugar solid contains
approximately 2-60 percent by weight of a monosaccharide; and

16 water.

 16. The composition of claim 15, wherein the sugar solid contains approximately 12-18 percent by weight of the monosaccharide.

 17. The composition of claim 16, further comprising a salt selected from the group consisting of magnesium chloride, sodium chloride, calcium chloride, and potassium
21 chloride.

 18. The composition of claim 17, further comprising a corrosion inhibitor.

1 19. A composition for reducing the buildup of snow and ice on a surface, comprising:
a de-icing agent containing a sugar solid, wherein the sugar solid contains
approximately 2-60 percent by weight of a monosaccharide; and
a corrosion inhibitor.

6 20. The composition of claim 19, further comprising a salt selected from the group
consisting of magnesium chloride, sodium chloride, calcium chloride, and potassium
chloride.

21. The composition of claim 19, wherein the sugar solid contains approximately 12-18
percent by weight of the monosaccharide.

11 22. The composition of claim 19, wherein the sugar solid contains approximately 14
percent by weight of the monosaccharide.

23. The composition of claim 19, wherein the sugar solid is mixed with water to form a
sugar-water mixture, and wherein the composition contains approximately 1-10 percent of
the corrosion inhibitor and 90-99 percent of the sugar-water mixture.

16 24. A composition for reducing the buildup of snow and ice on outdoor surfaces,
comprising:
a mixture of:
approximately 15-50 percent by weight on a dry basis of a sugar solid, wherein the
sugar solid contains approximately 2-60 percent by weight of a monosaccharide;
approximately 60-90 percent by weight on a dry basis of a salt; and
21 approximately 0.05-2 percent by weight on a dry basis of a corrosion inhibitor.

25. The composition of claim 24, further comprising water.

- 1 26. A composition for reducing the buildup of snow and ice on a surface, comprising:
 a sugar-water mixture having approximately 15 to 80 percent by weight of a sugar
 solid, wherein the sugar solid contains approximately 2-60 percent by weight of a
 monosaccharide; and
 a brine, wherein the brine contains 15-40% salt by weight.
- 6 27. The composition of claim 26, further comprising a corrosion inhibitor.
28. The composition of claim 27, wherein the composition contains approximately 50-
 95 percent by volume of the brine, 5-50 percent by volume of the sugar-water mixture, and
 0.5-5 percent by volume of the corrosion inhibitor.
29. The composition of claim 26, wherein the sugar-water mixture is corn syrup.
- 11 30. The composition of claim 29, wherein the corn syrup is 25 DE corn syrup.
31. The composition of claim 29, wherein the corn syrup is 36 DE corn syrup.
32. A composition for reducing the buildup of snow and ice on an outdoor surface,
 comprising:
 a sugar-water mixture having approximately 15 to 80 percent by weight of a sugar
16 solid, wherein the sugar solid contains approximately 2-60 percent by weight of a
 monosaccharide; and
 a corrosion inhibitor.
33. A composition for reducing the buildup of snow and ice on outdoor surfaces
 comprising:
21 (a) a steepwater solubles-water admixture;

1 (b) a sugar-water mixture combined with the steepwater solubles-water admixture; and

 (c) a brine mixture added to the steepwater solubles-water admixture and the sugar-water mixture.

34. The composition of claim 33, wherein the steepwater solubles-water admixture
6 contains approximately 30-70 percent by weight of steepwater solubles and 30-70 percent by weight of water.

35. The composition of claim 33, wherein the sugar-water mixture contains approximately 15-80 percent by weight of sugar.

36. The composition of claim 33, wherein the brine mixture contains approximately 30-
11 70 percent salt.

37. The composition of claim 33, wherein the composition contains about 80 percent by weight of the brine mixture, 6 to 7 percent by weight of the steepwater solubles-water admixture, and 13 to 14 percent by weight of the sugar-water mixture.

38. The composition of claim 33, wherein the composition contains about 50-95
16 percent by volume of the brine mixture, 0.5-20 percent by volume of the steepwater solubles-water admixture, and 5-50 percent by volume of the sugar-water mixture.

39. A method for reducing the buildup of snow and ice on an outdoor surface, comprising:

 applying to the outdoor surface a composition comprising:

1 a sugar-water mixture having approximately 15 to 80 percent by weight of a sugar
solid, wherein the sugar solid contains approximately 2-60 percent by weight of a
monosaccharide.

40. The method of claim 39, wherein the composition further comprises a corrosion
inhibitor.

6 41. The method of claim 40, wherein the corrosion inhibitor is sodium citrate.

42. The method of claim 40, wherein the composition further comprises a brine mixture
containing approximately 15 to 60 percent salt.

43. A composition for reducing the buildup of snow and ice on an outdoor surface,
comprising:

11 a sugar-water mixture having approximately 15 to 80 percent by weight of a sugar
solid, wherein the sugar solid contains approximately 2-60 percent by weight of a
monosaccharide;

 a corrosion inhibitor; and

 a steepwater solubles-water admixture.

16 44. The composition of claim 43, wherein the corrosion inhibitor is sodium citrate,
wherein the steepwater solubles-water admixture is 40-60 percent solids, and wherein the
sugar-water mixture is corn syrup having about 50-70 percent solids.

45. The composition of claim 44, wherein the composition contains about 90-95
percent by volume of the sugar-water mixture, 4-9 percent by volume of the steepwater
21 solubles-water admixture, and 0.5-2 percent by volume of the corrosion inhibitor.

Fig. 1

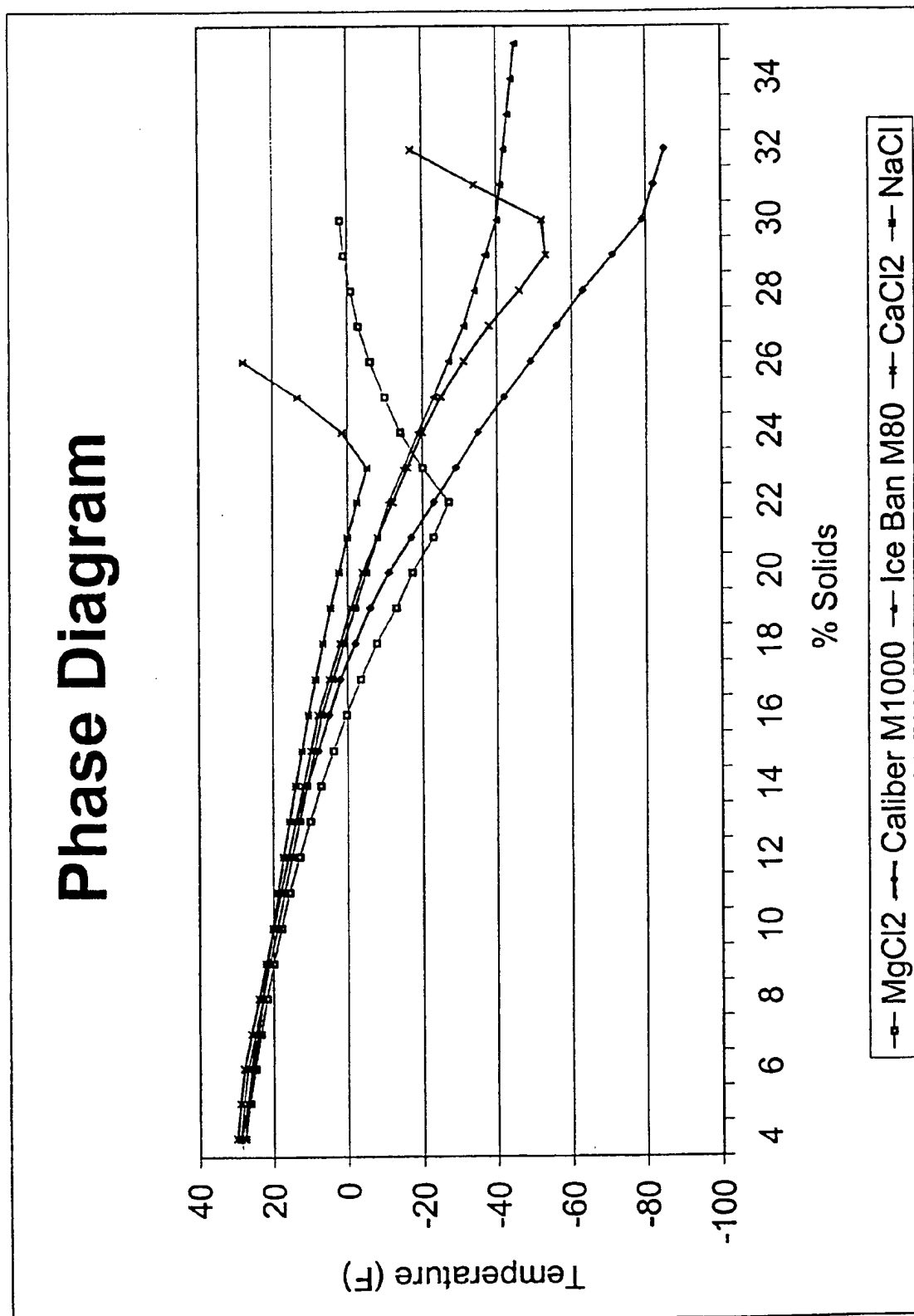


Fig. 2

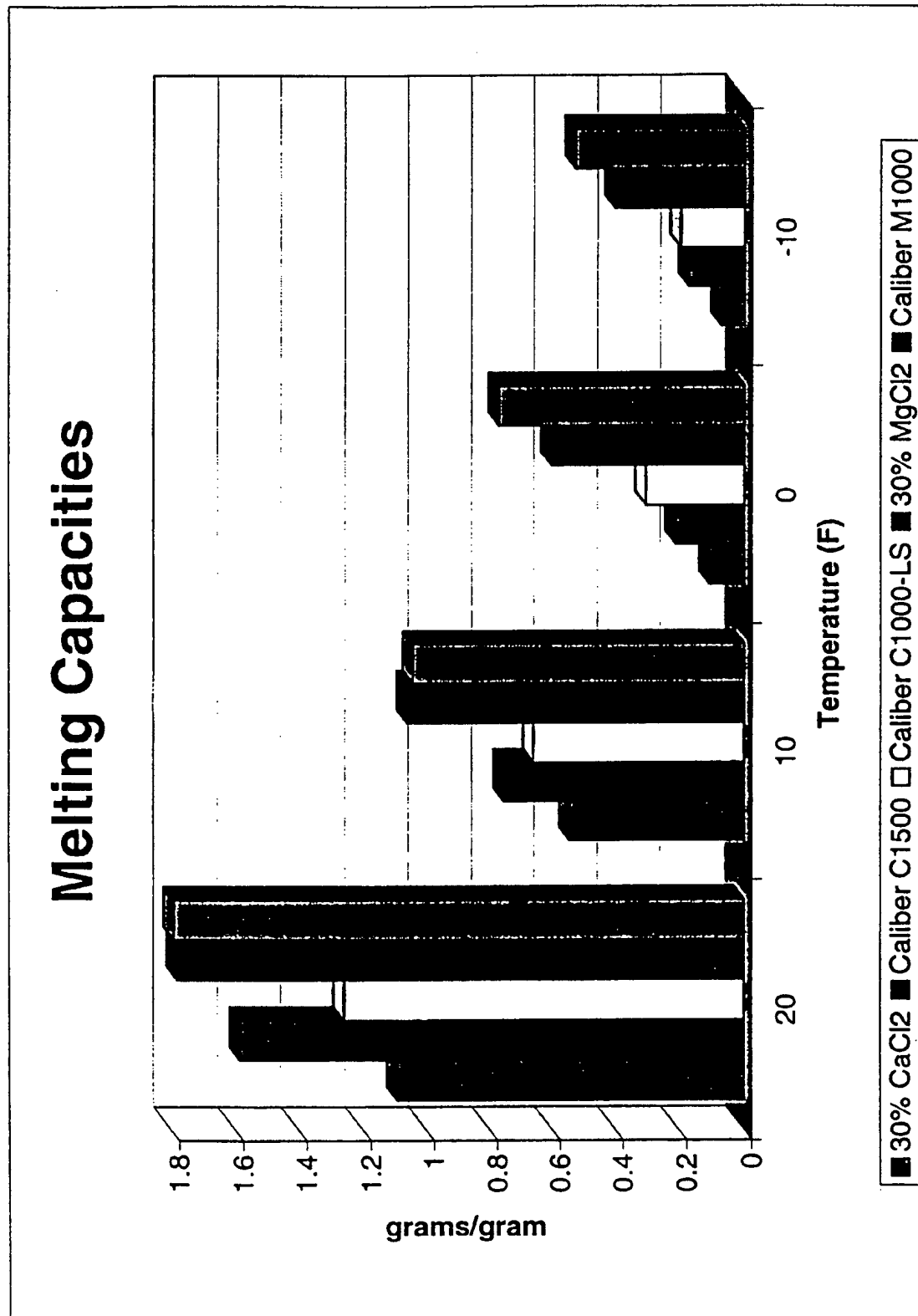


Fig. 3

Phase Data

% DS	MgCl2	CaCl2	NaCl	Ice Ban M50	Ice Ban M80	Caliber M1000	Caliber C1500	Caliber S1000
4	29	30	28	30	29	29	29	30
5	26	29	27	30	28	27	29	28
6	25	28	26	29	27	26	28	27
7	24	26	24	29	25	25	26	26
8	22	24	23	28	23	23	24	24
9	20	22	22	27	21	22	22	22
10	18	20	20	26	19	20	20	20
11	16	18	19	25	17	18	18	19
12	13	16	17	24	15	16	15	18
13	10	14	16	23	13	14	13	16
14	7	12	14	22	11	11	10	14
15	4	10	12	21	9	8	7	12
16	0	8	11	20	7	5	4	9
17	-3	5	9	19	4	2	1	6
18	-8	2	7	17	1	-2	-2	4
19	-13	-1	5	15	-2	-6	-5	2
20	-17	-4	2	13	-5	-11	-8	0
21	-23	-8	0	12	-8	-17	-11	-2
22	-27	-12	-3	10	-11	-23	-14	-4
23	-20	-16	-5	9	-15	-29	-21	-6
24	-14	-20	1	7	-19	-35	-25	-8
25	-10	-25	13	6	-23	-42	-29	-10
26	-6	-31	28	5	-27	-49	-33	-12
27	-3	-38		4	-31	-56	-37	
28	-1	-46		2	-34	-63	-43	
29	1	-53		1	-37	-71	-49	
30	2	-52		0	-40	-79	-56	
31		-34		-3	-41	-82	-63	
32		-17		-6	-42	-85	-70	
33				-9	-43		-63	
34				-12	-44		-55	
35				-15	-45		-47	
36				-17			-40	
37				-21				
38				-28				
39				-35				
40				-40				

Fig. 4

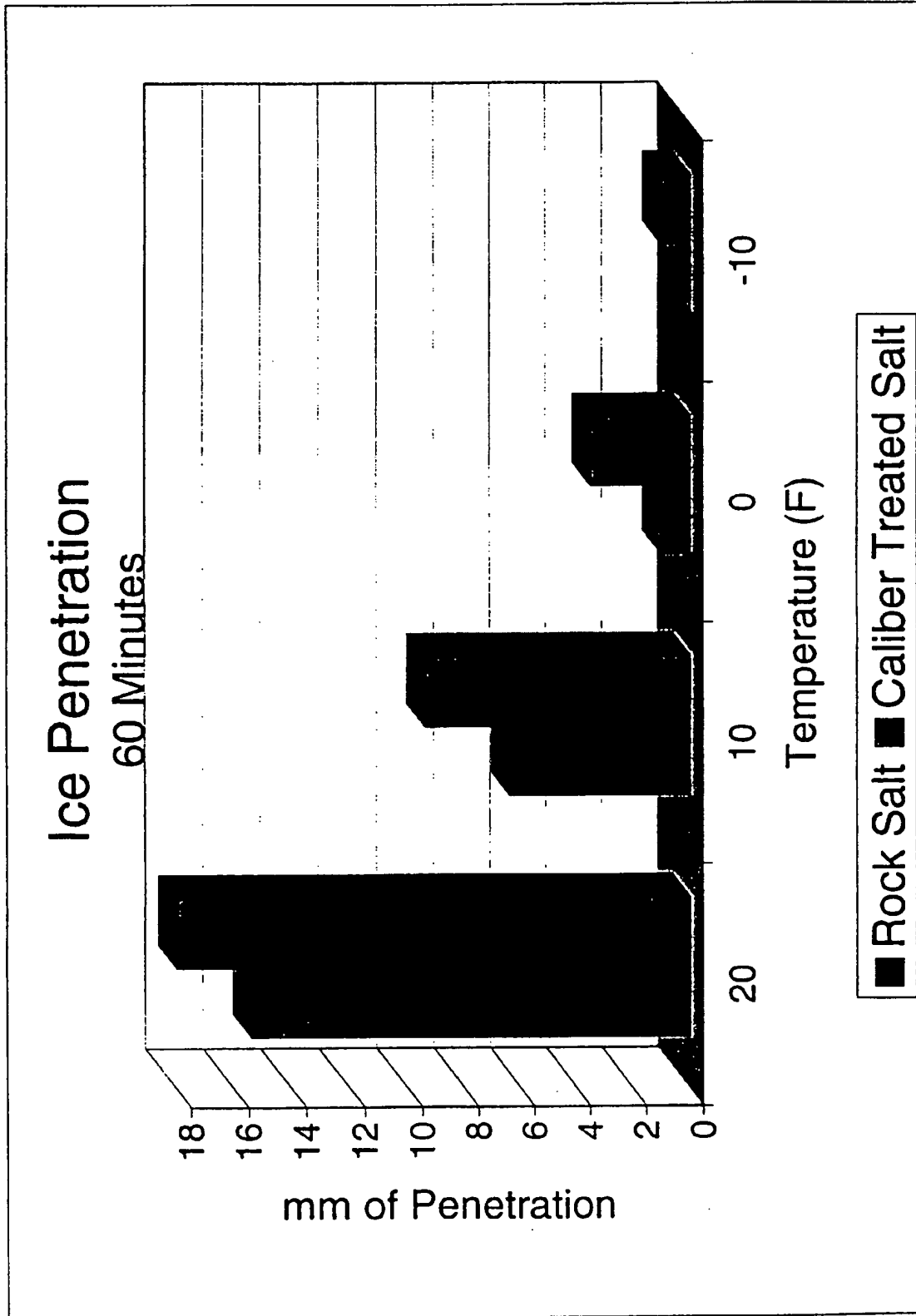


Fig. 5

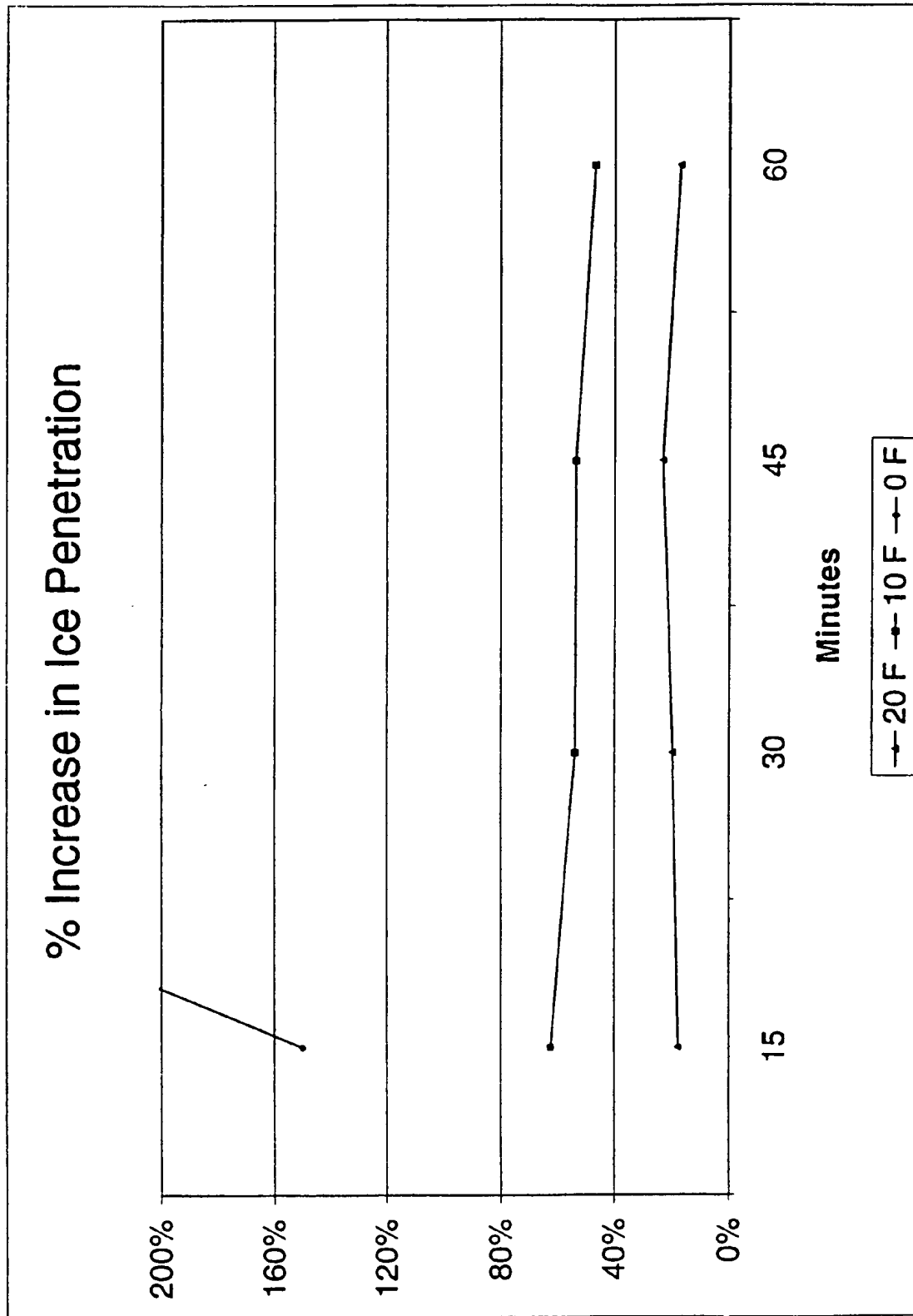


Fig. 6

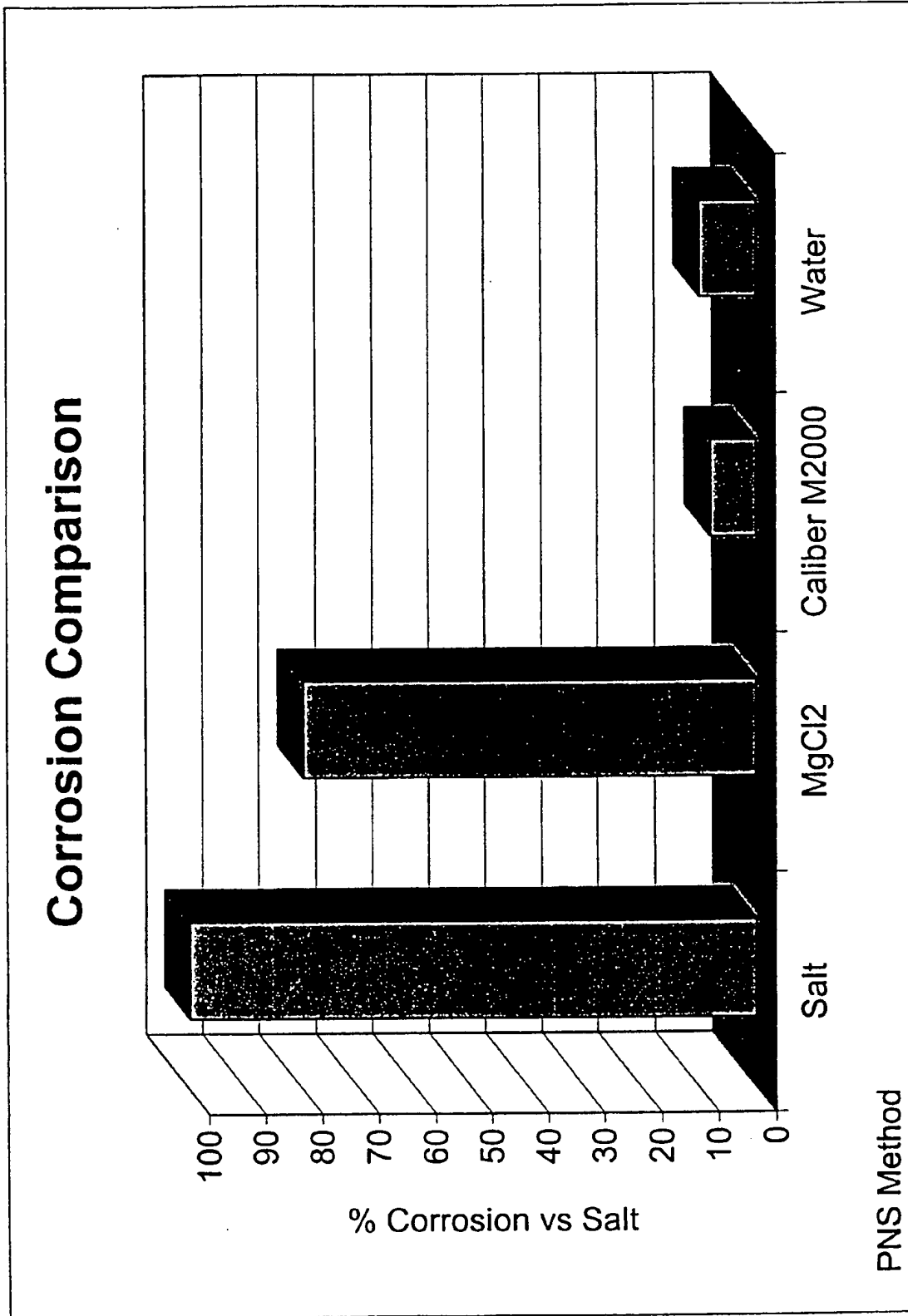


Fig. 7

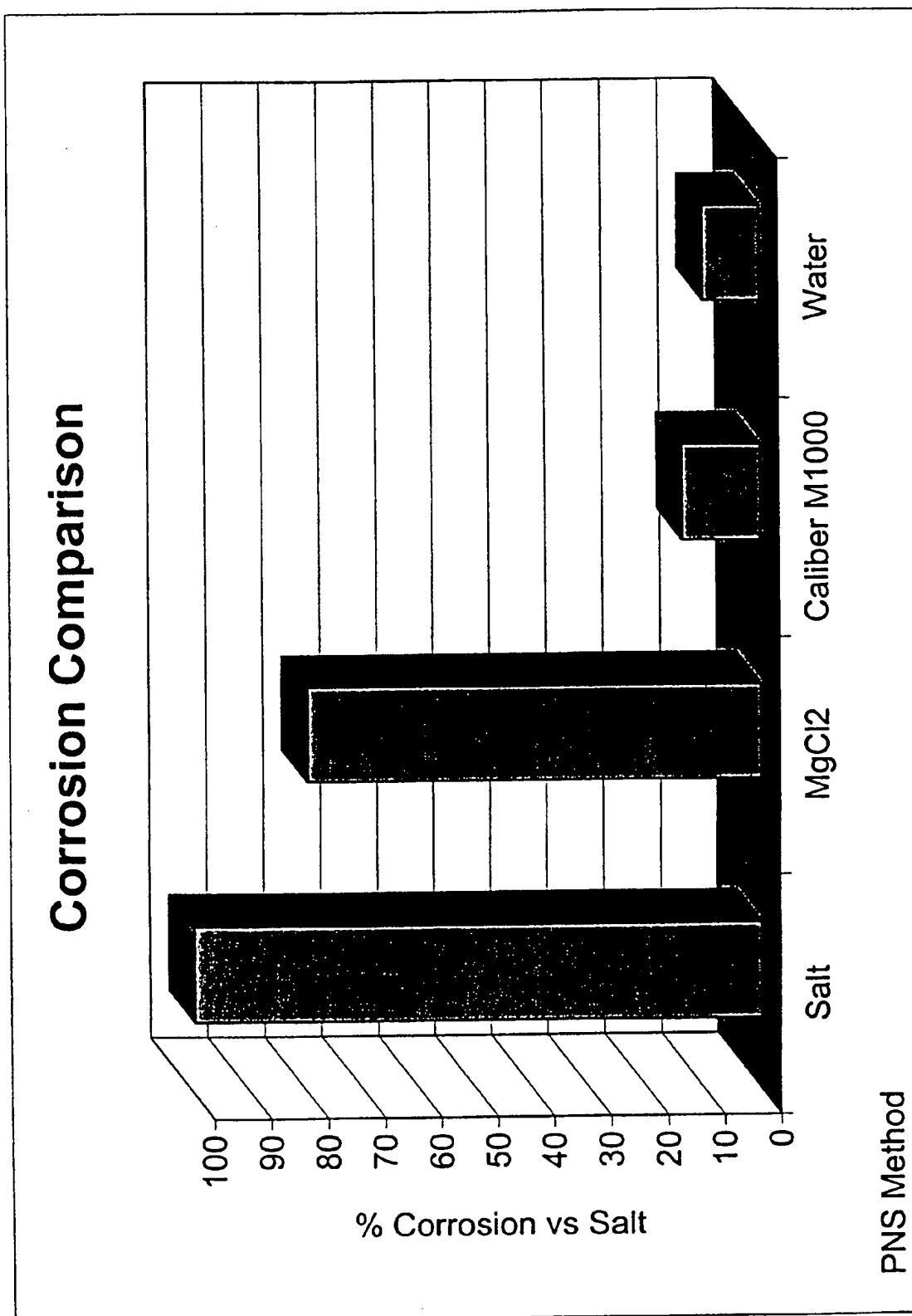


Fig. 8

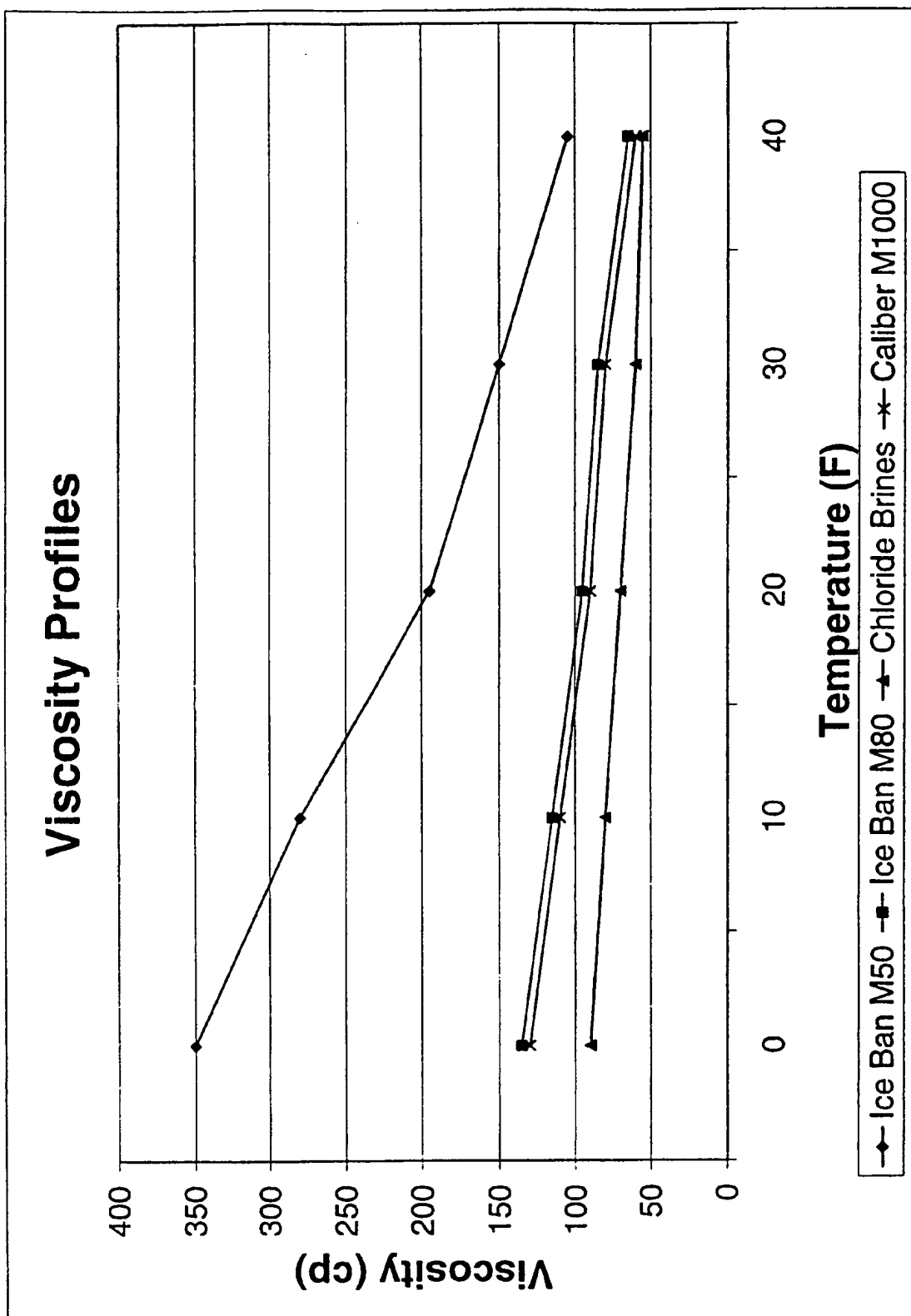
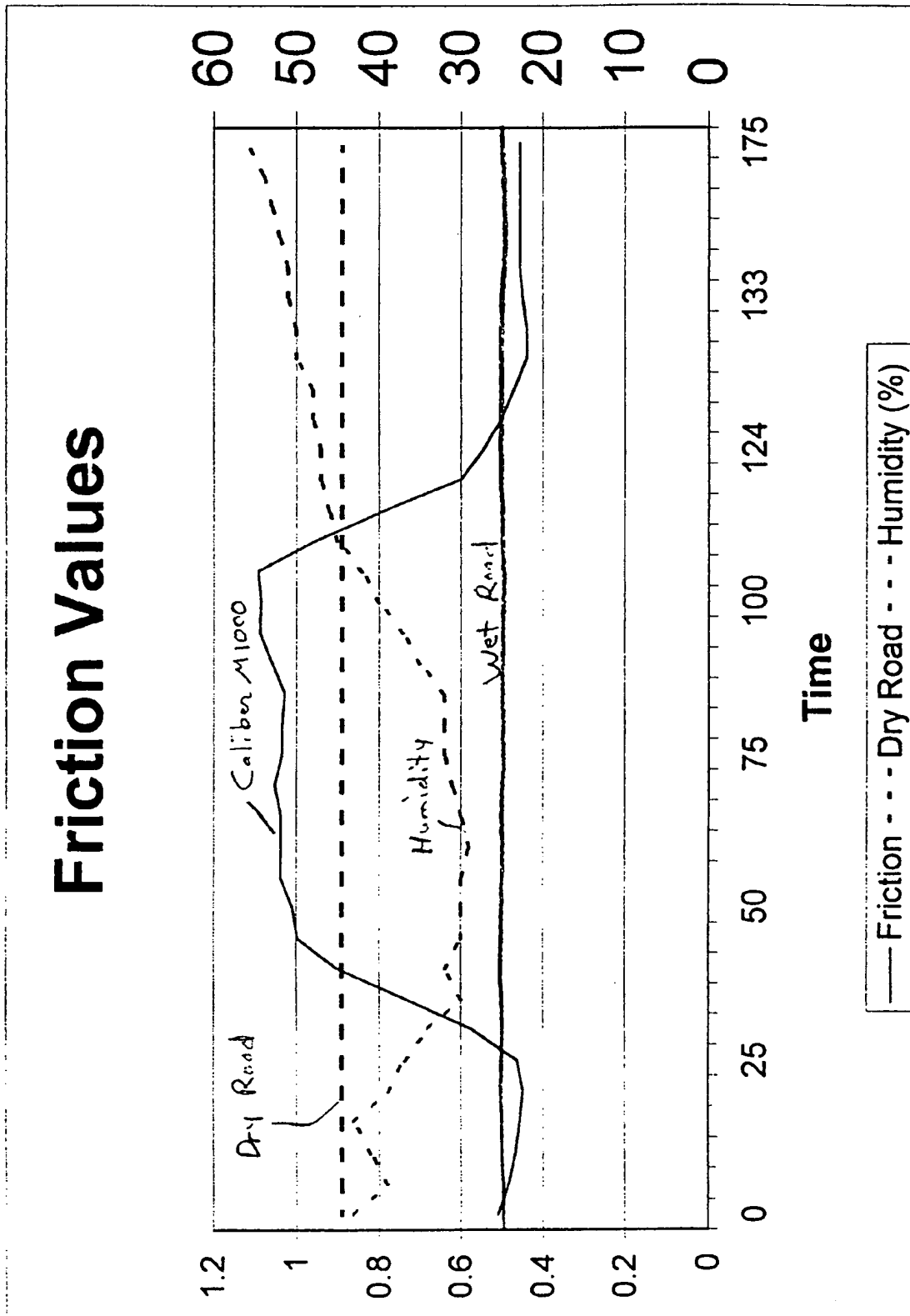


Fig. 9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US00/20218

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :C09K 3/18

US CL :106/13: 252/70

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 106/13: 252/70

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WEST

search terms: deicing, antiicing, sugar, corn syrup, steepwater

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,430,240 A (SANDVIG et al) 7 February 1984.	1-45
A	US 4,676,918 A (TOTH et al) 30 June 1987.	1-45
A	US 4,824,588 A (LIN) 25 April 1989.	1-45
A	US 5,635,101 (JANKE et al) 3 June 1997.	1-45
A	US 5,709,813 A (JANKE et al) 20 January 1998.	1-45
A	US 5,849,356 A (GAMBINO et al) 15 December 1998.	1-45
A	US 5,876,621 A (SAPIENZA) 2 March 1999.	1-45
A,P	US 5,932,135 A (JANKE et al) 3 August 1999.	1-45

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

13 OCTOBER 2000

Date of mailing of the international search report

14 NOV 2000

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/20218

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A,P	US 5,965,058 A (JANKE et al) 12 October 1999.	1-45
A,E	US 6,080,330 A (BLOOMER) 27 JUNE 2000.	1-45